Food & wood – or fuel?

Where is the land for planting dedicated energy crops in the United Kingdom?

The principle of using agricultural land to grow grasses (such as miscanthus) and marginal land to grow trees (in short rotation coppice and/or short rotation forestry systems) as dedicated energy crops in the United Kingdom is now well established. Dedicated energy crops have been described as having the potential to provide:

- cheaper fuel due to the probable long-term increases in fossil fuel prices associated with peak oil,
- improved energy security,
- a reduction in carbon emissions as this renewable resource can provide a more carbon lean form of energy.

However, planting dedicated energy crops will reduce the land available for other land use sectors in the UK, specifically for the domestic supply of food and wood products. A recent Chatham House report *Food futures; rethinking UK strategy* recognised that, "Questions are arising about the availability, accessibility and affordability of food, land, water, energy and skills," but failed to include our continued requirement for wood (Ambler-Edwards *et al*, 2009). It is important to understand the extent to which land in the UK is currently able to supply both the food and the wood demand of our population. Determining the degree to which we are self-sufficient in food and wood will enable us to consider whether there is sufficient land available for the large-scale planting of dedicated energy crops to make a viable contribution to our future energy requirement.

The data necessary to calculate the extent to which land in the UK is currently able to supply the food and wood demand of our population are relatively easy to obtain. Six current national statistics about UK population, land area, land use and self-sufficiency from the Office of National Statistics (ONS), Department for the Environment Food and Rural Affairs (Defra) and the Forestry Commission (FC) websites are all that are required, namely:

- the UK population reached 60,975,000 people in mid-2007 (ONS, 2008),
- the total land cover of the UK is approximately 24 million hectares (Defra, 2004) (Figure 1a),
- agricultural activities cover about three quarters (75%) of the land area in the UK (Defra, 2007) (Figure 1b),
- the area of woodland in the UK is 2.8 million hectares (FC, 2008a), so our percentage woodland cover is approximately 12% (Figure 1b),
- the UK is a net importer of food; it is 60% self-sufficient in all food (Defra, 2007),
- the UK is a net importer of wood; it is 16% self-sufficient in all wood (calculated as UK production / UK production + imports – exports) (FC, 2008b).

These data have been used in three calculations (shown in Box 1) to determine that we would need double the land area of the UK planted with crops and trees to supply the food and wood demand of our current population. From this a fourth calculation (also shown in Box 1) indicates that, with our current pattern of land use and at current rates of productivity, the UK can only be self-sufficient in food and wood for approximately 27 million people, less than half of its current population. The results have been used to graphically represent the land area required to provide food and wood to the current UK population (Figure 1).

A sustainable UK population of approximately 27 million people probably appears incredibly low to those unaccustomed to thinking about sustainable population sizes, but it is at the higher end of the range of other estimates for the UK. For example, calculations using a range of national carbon emissions have been undertaken for the Optimum Population Trust suggesting that, depending on how much we are able to reduce our carbon emissions, the sustainable population of the UK is 17 to 27 million people (Desvaux, 2008).

It could be argued that this calculation is unrealistic because we do not have the climate to produce all the food types we consume. However, to be truly sustainable in food, any imports of exotic foods should be matched by exports of indigenous food (*ie* food types that we are able to grow ourselves). Nonetheless, it is worth considering the effect on the calculation of attempting to be self-sufficient in indigenous food only. The UK is 74% self-sufficient for indigenous foods (Defra, 2007). Replacing the 60% figure for self-sufficiency in all foods with 74% for self-sufficiency in indigenous food in the calculations in Box 1 would suggest that 101% of the land area of the UK would need to be farmland to make us self-sufficient in food. This would mean that 189% of our land area would need to be farmed and forested to make us self-sufficient in both food and wood, indicating that, with our current pattern of land use and at current rates of productivity, the UK would be self-sufficient in food and wood for almost 30,141,051 people, still less than half (49%) of its current population.

There are six theoretical options for overcoming this imbalance. These are listed below with a brief explanation of why each is impractical:

(1) Increase the size of our land. Invading northern France may have worked for Henry V in the 15th century, but it is no longer a viable option. In fact the land area of the UK is currently predicted to shrink due to sea level rises associated with climate change.

(2) Buy land elsewhere. Other countries are already doing this. For example, in 2008 Daewoo Logistics purchased a 99-year lease on approximately half the arable land in Madagascar to supply South Korea with corn. However, this kind of neo-colonialism does not improve self-sufficiency, just secures imports.

(3) Allocate more of our existing land to agriculture and forestry. However, as agricultural and forestry already comprise the vast majority (87%) of our land cover, only small increases are possible. The population has to live somewhere and mountainous land, coastal sand and inland water will simply not support the food, fibre or fuel crops.

(4) Increase our food and wood productivity. Some improvements in productivity are possible if the population as a whole changes its food consumption patterns. For example, the Elliasch Review (2008) reported land use requirements for different types of food production. This indicated that a switch to vegetarianism would enable the land to produce more food. However, it seems unlikely that a wholesale switch to vegetarianism will occur in the UK in the short to medium term.

(5) Reduce the population size. This would make the UK more self-sufficient on the land area and at the productivity rates we have. However, current projections indicate that the population of the UK will continue to rise by 0.7% per year, reaching 71 million in 2031.

(6) Reduce the demand of the existing population for food and wood. Although increases in obesity indicate there is some potential for slimming down the UK population, it is not likely to be on the scale necessary to markedly reduce our food demand. However, reducing food waste is a policy that could reduce demand. It has been calculated that

Box 1. The land area required to supply food and wood to the current population of the UK and the population for which the UK is self-sufficient at current levels of food and wood production.

Four calculation steps to determine the number of people in the UK for whom we can be self-sufficient in food and wood at current rates of productivity:

1. 75% of our land is used to produce 60% of our food requirement, thus:

   Self-sufficiency in food = 75 x 100 / 60 = 125

   ie 125% of the land area of the UK would need to be farmland to make us self-sufficient in food (Figure 1c).

2. 12% of the land is used to produce 16% of our wood requirement, thus:

   Self-sufficiency in wood = 12 x 100 / 16 = 75

   ie 75% of the land area of the UK would need to be woodland to make us self-sufficient in wood (Figure 1d).

3. if we need 125% of our land area to become self-sufficient in food and 75% of our land area to become self-sufficient in wood, then:

   Self-sufficiency in food and wood = 125 + 75 = 200

   ie 200% of our land area would need to be farmed and forested to make us self-sufficient in both food and wood.

   However, 1% of the UK is inland water and 12% is urban/not specified land where there are only very small opportunities for land use change (Figure 1b). So 213% of the actual area of the UK is required to make us self-sufficient in food and wood (Figure 1e).

4. if we need to use double the land area of the UK to provide food and wood for 60,975,000 people, then the sustainable population on the existing land is:

   Self-sufficiency = 60,975,000 x 100 / 200 = 30,487,500

   However, as only 87% of our land is actually used for food and wood production (Figure 1b), the calculation should be:

   Self-sufficiency = 60,975,000 x 87 / 200 = 26,524,125

   ie with our current pattern of land use and at current rates of productivity, the UK is self-sufficient in food and wood for approximately 27 million people, less than half of its current population.

Figure 1. The area of the UK represented as (a) a simple grey square comprising 100 x 100 = 10,000 cells, (b) by different broad categories of current land use within that square (*eg* 12% forest cover is represented by a band of 1,200 cells), (c) with the additional land requirement beyond the square to become self-sufficient in food, (d) wood and (e) both food and wood. This is for the current population assuming that current land use within the UK and rates of food and wood productivity remain unchanged.

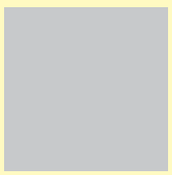

Figure 1a. The area of the UK (24 million hectares) represented by a simple grey square.

Figure 1b. Current percentages of land use of the land cover of the UK.

- 12% urban/not specified
- 1% inland water
- 12% forestry
- 75% agriculture

Figure 1c. We would need to use 125% of our current land area to become self-sufficient in food (*ie* 67% more than is used now, equivalent to increasing the land area of the UK by 50% to incorporate additional farmland).

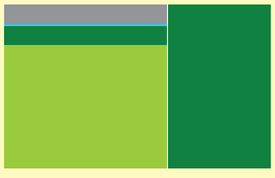

Figure 1d. We would need 75% of our current land area to become self-sufficient in forestry (*ie* approximately 6 times as much as is used now, equivalent to increasing the land area of the UK by 63% to incorporate additional woodland).

Figure 1e. We would need to plant 200% of our land area with crops and trees, *ie* we need to more than double (50% + 63% = 213%) the land area of the UK to become self-sufficient in both food and forestry.

18-20 million tonnes of food are wasted in the UK per year, of which 6.7 million tonnes of food is wasted by British consumers (WRAP, 2008). Depending upon how much of this waste could be eradicated, it might be possible for the UK to be self-sufficient in indigenous food but probably not in all food. Similarly, some reduction of wood waste by consumers and in the supply chain may be possible, but our wood trade deficit is so great that this would be unlikely to markedly reduce our dependence on imports.

A seventh option is not to worry about it. To simply decide that self-sufficiency is not an important objective for the UK. There is no need for anyone to starve, or for us to drastically reduce our population size, as being part of the European Union makes us part of a larger land area that is more than 90% self-sufficient in food (Defra, 2007). We also have other well established trade links around the world. For example, 62% of our wood pulp is imported from non-European countries.

However, the government has stated that reducing carbon emissions is an important objective for the UK. We should therefore be aiming to reduce all our carbon emissions, including those from our net imports. Shipping was not included in the carbon accounting systems under the Kyoto Protocol, but will almost certainly be part of the post-Kyoto agreement to be agreed through the United Nations Framework Convention on Climate Change meeting in Copenhagen in 2009. This means that the carbon costs of all imports, including food and wood, will be coming under increasing scrutiny.

The aim of this article is to highlight the degree to which the UK is self-sufficient in food and wood to enable us to consider whether there is sufficient land available for the large-scale planting of dedicated energy crops to make a viable contribution to our future energy requirement. Calculations from national statistics that are easily obtained have shown that the UK only has sufficient land to sustain the food and wood requirements of approximately 27 million people, less than half (44%) of the current UK population. Clearly we cannot supply the food and wood we need from land we have, even if we could dramatically reduce demand and increase productivity. Dedicated energy crops, by their very definition, do not contribute to food or wood supply, so any change in land use to plant these crops would have a negative impact on our self-sufficiency in food and wood. Thus, planting dedicated energy crops to contribute to our future energy requirement would inevitably necessitate an increase in energy use (and associated fuel costs and carbon emissions) for the long-distance transportation of food and wood imports.

To reduce our imports, we already need to maximise the land cover that is dedicated to producing the food and wood we need and increase the productivity of our existing farmland and woodland. It will prove extremely difficult to find land for dedicated energy crops without having a negative impact on food and wood production. However, there is some potential for UK farmland and woodland to contribute to our energy requirement through the increased utilisation of food and wood by-products as a source of bioenergy. For example, harvesting crop and tree residues can provide biomass for bioenergy. In forestry, bioenergy can also be obtained while improving silviculture by harvesting first thinnings from commercial tree plantations and bringing the many underutilised woodlands back into management.

It is likely and desirable that the most productive land in the UK will continue to be used to produce food. So, if dedicated energy crops are to be planted extensively, it will probably be at the expense of forestry on more marginal land. Planting dedicated energy crops might lead to some benefit for the single objective of future energy supply, but this should be compared to the increasingly diverse benefits that have been provided by forests managed for multiple objectives in recent years. Forestry in the UK provides a range of ecosystem services including clean water, biodiversity, recreation and a long-term carbon store, as well as timber production. Net photosynthesis by plants removes carbon dioxide from the atmosphere. Some of the carbon is transferred into the soil and in forests can be retained beyond the lifespan of individual trees. This is true carbon capture and storage. Other renewable energy options can help us to avoid further carbon dioxide emissions from fossil fuel use, but no other options reduce the current level of carbon dioxide in the atmosphere which is already elevated by anthropogenic emissions. Furthermore, the best carbon substitution effect (*ie* the saving in carbon dioxide emissions from alternatives to fossil fuel use) appears to be achieved by using timber instead of concrete and steel in construction, not through the direct replacement of fossil fuels with fuel wood. Consequently, it would seem better to consider whether any available land could be used to produce timber (with fuel as a by-product of good silvicultural practice), rather than for dedicated energy crops.

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A full list of sources and references for the above is available on request from Forestry Journal.